Construction and Maintenance of Turf Roofs in the North Atlantic Region

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Churchill Fellow 2005

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1.0 Summary

During April and early May 2006 I travelled to the Færoe Islands, Iceland and Norway to investigate the use of turf as a roofing material on traditional buildings. It was hoped that a comparison of the methodologies of traditional turf roof construction would assist in the repair and maintenance of turf roofs on St Kilda in the Western Isles of Scotland. The study revealed that there are a number of different methodologies and traditions but all are affected by similar factors of climate, time of year, aftercare and appropriate material.

2.0 Introduction

The use of turf as a building and roofing material is well documented in historic texts from most areas of northern Europe and probably has an origin in prehistory. Its use declined in many areas in the 18th & 19th centuries but did survive into the 20th century in a very few areas, particularly in north Atlantic Europe.

This study looked at roofs in three areas in the north Atlantic: the Færoe Islands, Iceland and Norway. It considered the method of construction as well as factors which may have an affect on the success or failure of the roof; these included– size, age and use of the building, time of year of construction / repair, aspect, steepness of slope, climate maintenance and varieties of grass.

This report will look at each area in turn and describe the different methods of construction and repair observed.

It was hoped that by studying the construction and repair methods in these area that improvements could be made to the process of repairing and replacing roofs on St Kilda. The native islanders used turf to roof their storehouses or *cleits.* When the island was abandoned in 1930 a great deal of knowledge about traditional building methods on St Kilda was lost.

3.0 Case Studies

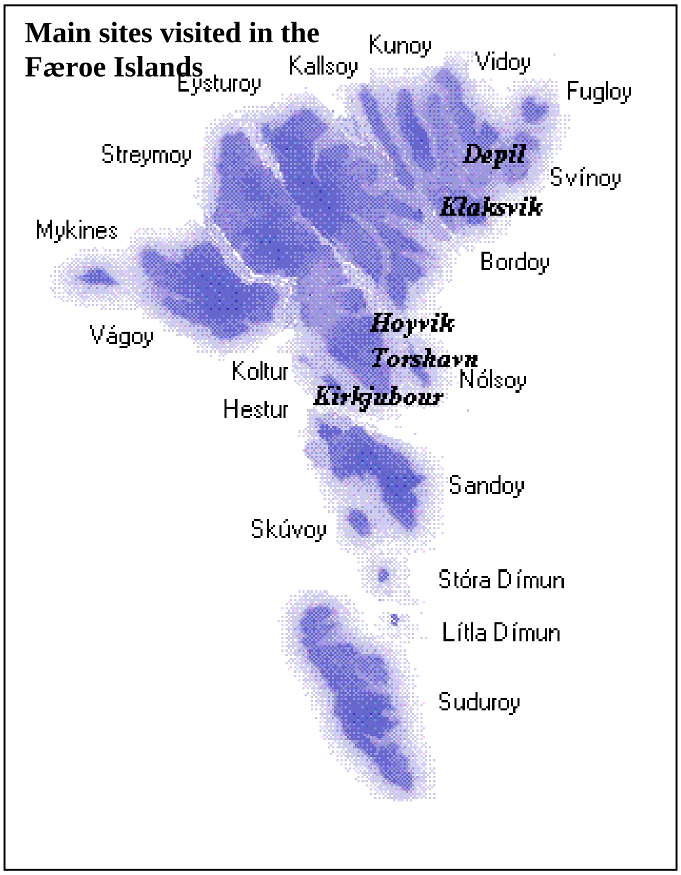
Each site that had an extended visit is detailed below. These visits were usually accompanied with the owner, member of museum staff or someone who could explain the history and method of construction / repair. The description of the construction and maintenance of the roof is as told. Unaccompanied visits to other sites are not detailed below but reference where appropriate is made.

3.1 The Færoe Islands

Introduction

The Færoe Islands are a group of eighteen islands lying in the north Atlantic, midway between Scotland, Norway and Iceland. Their nearest neighbours are the Shetland Islands, 180 miles to the southeast. The Færoe Islands were first settled in the 7th-8th centuries by Irish monks followed by larger scale settlement and immigration from Norway in the 9th century.

The islands have a temperate maritime climate, the temperature rarely falls below freezing and in summer averages only 12˚c, cloud cover is common, rainfall occurs on average 280 days of the year and it is frequently windy. During my visit in early April, there were several snow showers, torrential rain and warm sunshine.



Main sites visited in the Færoe Islands

Study Summary

Turf has been used as a building and roofing material since the early settlement of the islands and continues to this day. It is found on many historic and modern buildings and is to some extent an expression of Færoese identity; the Nordic Centre – a large, modern civic building in central Tórshavn is roofed in turf. Turf roofs occur all over the Færoe Islands and are found on all types of buildings, from the smallest – goose houses and kennels, to the largest – churches and civic buildings.

Sites on three separate islands were visited, ranging from the island of Borđoy in the north to Suđoroy in the south. Interviews were carried out with architects, builders and archaeologists from the National Museum and a farmer and roofer.

Turf roofs are found on a wide range of buildings; from the smallest to the largest.

Kirkjubøur

The community of Kirkjubøur lies at the southern tip of the main island of Stremoy. The main farmhouse, *Roykstovan,* is a split log building, parts of which are medieval. The farm has been within the same family since the 16th century.

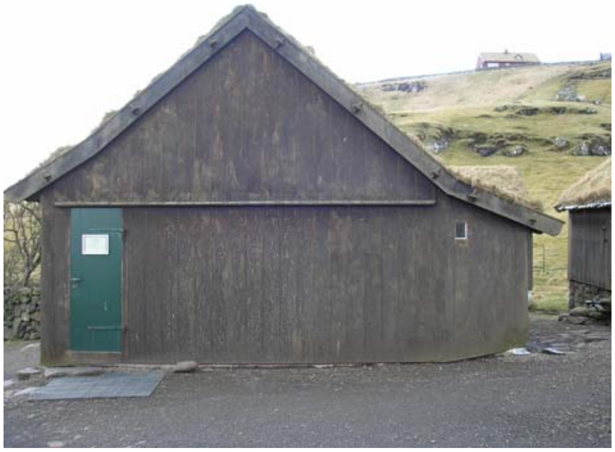
All the domestic buildings in Kirkjubøur have turf roofs. The owner and farmer, Mr. Joannes Patursson, kindly spent some time with me describing how they had replaced the roof some 5 years previously. The roof had started to let in water, indicating a problem with the lower waterproof layer. All the old material was removed, none of it was re-used. The sarking was replaced and two layers of tarred paper were laid on top of this, followed by a rubberized membrane to form the waterproof layer. Then two layers of turf were laid, each approximately 5cm thick, the first grass down, the next grass up. In between the

Roykstovan *farmhouse, the roof was replaced in 2001.*

layers a fishing net was laid. The grass was cut from nearby a paddock, from an area that had not been fertilized recently. The turf was firmed in place by walking on it and pressing it down firmly. This work was carried our in late April /early May. The after care was limited to watering it in the first two weeks.
Over the first two-three years the species composition was expected to change to become more drought tolerant varieties. In the past, 'Lundasina', a type of grass found in puffin colonies, was chosen for its tolerance to extreme conditions, this practice no longer seems to take place. The threats to the roof are drying out and blowing away and so as a result the vulnerable areas are the southern aspect, ridge line and edges.

Hoyvik

The open air museum at Hoyvik, on the outskirts of Tórshavn, lies on the east coast of the main island of Stremoy. Two days were spent here with staff from the Føroya Fornminnissavn, the National Museum, discussing the methodologies and history of repair as well as the philosophy behind different methodologies e.g. the use of modern materials in traditional buildings.
A range of agricultural buildings are constructed at Hoyvik; farmhouses, barns, cattle-sheds, pigsties and poultry houses. The buildings are constructed of timber, stone or corrugated tin, but all have a timber roof construction.



The farmhouse roof at Hoyvik was replaced in 2000. The farmhouse was timber frame construction on stone foundations; the building was approximately 12m x 6m with the ridge along the east-west access. In profile the roof was approximately 40˚pitch which kicked out at the base to form a shallower pitch. The roof was repaired using a combination of traditional and modern methods. A plastic dimpled membrane was used as the waterproof layer over the roof timbers, with a layer of birch bark along the edge to give a traditional look. Nylon fishing net was laid across the plastic to provide the root system something to hold onto. The turfs were cut from a nearby field that had been used for occasional grazing. The turfs were a maximum of 0.15m deep and approximately 0.25m x 0.15. This shape of the turf was called a 'milk carton' as it resembled a 1 litre carton. These turfs were laid in rows, starting at the bottom. The first row was laid resting against the wooden base board or 'turf-stopper' with the grass side facing towards the ridge. Then the next row was laid with the seams off set from the first. Again the grass was not facing upwards but was closest to the ridge, so that when complete the roof looked like brown soil with thin green stripes running horizontally across it. This is not the most common method of repair but is not unknown.

Klaksvik

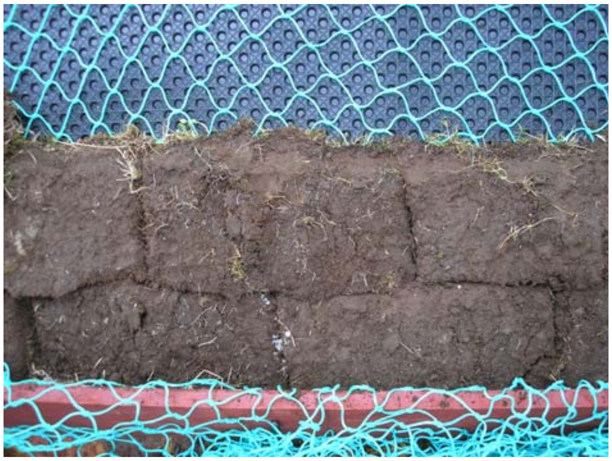
Klaksvik is the second largest town in the Færoe Islands on the northerly island of Borđoy. The Nordoya Fornminnissavn (Northern Islands Museum) were restoring part of a late 19th century timber building in the centre of the town, this included re-instating the original turf roof.

The turf for the roof was cut from an nearby outfield

All the turf had been removed from the roof and new turf cut from a field on the outskirts of the village.

The field had not been grazed for a few years and the opinion was expressed that good grazing land would not be used for roofing, and roof turfs should be sourced from the outfield land. The turf had been cut approximately 4 weeks earlier and stored on site, next to the building to be roofed. It was stated that normally turf would be cut closer to the time when it was to be used but it wasn't felt to be a significant problem. The turfs were approximately 70mm thick and 0.4m x 0.3m.

A plastic waterproof membrane was tacked onto the old tarred felt layer, with a layer of birch bark along the roof edge so that when complete the roof would look authentic with the birch bark peeking out below the turf. This plastic layer is specially designed for turf roofs and has small dimples to store little reservoirs of water. However it has a very smooth surface which is difficult for a root system to grip. Therefore an old plastic fishing net was laid across the roof and secured in a few places with nails. One layer of turf was then laid grass side down, starting from the bottom and working to the ridge. The turfs had been cut with an angular edge so that they overlapped slightly and they were laid with the joints off set – like brick work.



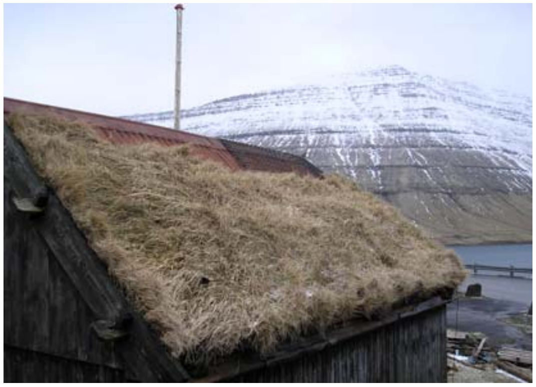
The first layer of turf is laid grass down over the waterproof sheet and net.

Each turf was thumped firmly in place. The fishing net was then folded over this layer of turf and a second layer of turfs laid on top, this time grass up. At this point, before the turfs have knitted together, the roof is vulnerable to the wind drying the turfs out or catching an edge. The design of most roofs in the Færoe Islands protects the turf from the worst affects with a timber base board along the bottom (called a 'turf stopper' in Færoese) and with barge boards along the gables. The roofer said he sometimes puts some fertilizer in between the layers but it wasn't necessary and, as it had started to rain, he wasn't going to water it in. There was no after care, the roof was too high to cut or graze and they expected it should last 30-50 years, with perhaps some minor repairs along the ridge or edges.

Depil

The longhouse at Depil is a 19th century building with its origin in a much earlier period. It is a typical old style farmhouse with living accommodation at one end and a barn and byre at the other. The blackhouses of Highland Scotland are of the same tradition. There were three separate outbuildings, a stone-built store -*grothus* and two wooden stores or *hjallur.* All the buildings, except the *grothus,* had turf roofs. The main longhouse had been re-roofed in the past 10 years as part of a modernization of the building that is still inhabited. The turf was cut locally from the outfield land and laid in the two-layer method as described at Klaksvik. A net was laid over the turf and weighted down. The ridge at Depil has been repaired since then; the ridge is vulnerable to drying out and the insertion of modern roof-lights along the ridge may have exacerbated the problem.

The *hjallur* also had a turf roof, this was laid over corrugated tin, and this too had problems, probably because the tin does not offer a good surface for the roots to grip.



Problems using turf on corrugated tin – there is little for the roots to hold onto

Tinganes, Tórshavn

Tinganes is the centre of old Tórshavn and consists of mainly 17th-18th century wooden buildings densely clustered on a peninsula; the majority of buildings have turf roofs. Many of the buildings are private homes and businesses, but as this part of the town is a conservation area there are guidelines on roofing materials, with turf, when appropriate, being preferred to maintain the character of the area. Most of the roofs that had been repaired in the last 20 years used a plastic membrane as the waterproof layer; plastic lasts longer and is cheaper. Birch bark is only used along the edge to create a traditional look.

The majority of the roofs used the two-layer method, with the bottom layer grass-down and the top layer grass up. The turfs on some roof were large squares, up to 0.5m x 0.5m. Traditionally home owners in Tinganes had the rights to cut turf on the edge of town, although some of these areas are now under housing and so turf has to be bought or given from other areas.

The most common grasses seemed to be *Agrostis* (bent) and *Deschampsia flexuosa* (wavy hair-grass), although there was also *Luzula sylvatica*s (wood rush*)* and bryophytes. Garden flowers were also noted i.e. narcissi

Conclusion

The Færoe Islands still have a living tradition of using turf as a roofing material and perhaps because of this a number of variations of construction and repair methods were encountered, combining both traditional and modern methods and materials. Turf was always sourced from the outfield or land that was no longer grazed; these grasses would be used to a nutrient poor soil. Although on one occasion, at Hoyvik, the area to be cut was fertilized some weeks before. However this did not seem to be a common practice. The turf was normally cut immediately before use but again this was not necessary and the turf at Klaksvik seemed remarkably resistant to poor treatment!

I saw two different methods of laying turf, the two layer method and the ‘milk carton’ method. The two layer method was by far the most common. However a third method, described as being more traditional, did not seem to be common practice any more and I was not able to source any examples of it. This used wedge-shaped turf, laid alternately grass down and grass up.

All turf was laid on some sort of waterproof layer, traditionally this was birch bark. Today for reasons of cost and accessibility (all bark has to be imported from Sweden or Russia) this has often been replaced with a specialist plastic membrane, although bitumous felt, rubberised membranes and corrugated tin were all noted. Most non-traditional waterproof surfaces are slippy and it was common to add a fishing net layer. Old fishing nets are readily available and provide something for the roots to grip onto. Weighted nets were also used over the top of a completed roof to hold everything in place. The waterproof layer was the most important part and the turf is used to keep it in place and also for its good insulating properties.

Aftercare was minimal or non-existent, but as many roofs are difficult to access this makes sense. Roofs were occasionally fertilised as they were made and sometimes watered in the first few weeks. Cutting the grass seemed to be for aesthetic reasons only.

Most people agreed that two factors were important:

- the repairs are normally carried out in the spring (April / May and into June) to allow the roof to grow over the summer
- the new roof should be protected from wind and drying out until it has established and knitted together- this was achieved through barge boards around the edges and sometimes the use of weighted fishing nets over the top. In the past they had also put stones and/or timber directly on top of the turf. A number of archive images in the museum collection showed this but it did not seem to be common practice now.

Factors such as roof area, grazing and steepness of slope did not appear to be major influences in success or failure. Opinion was divided in the use of poor quality grassland, some believed that this was to save good grassland for grazing; others felt that poor quality was better for roofs as the grass was better suited to stressful conditions.

The Færoese climate is probably ideal for grass growing, with a temperate maritime climate. Average temperatures vary from 3˚c in January to 11˚c in July and rain can be expected 280 days of the year.

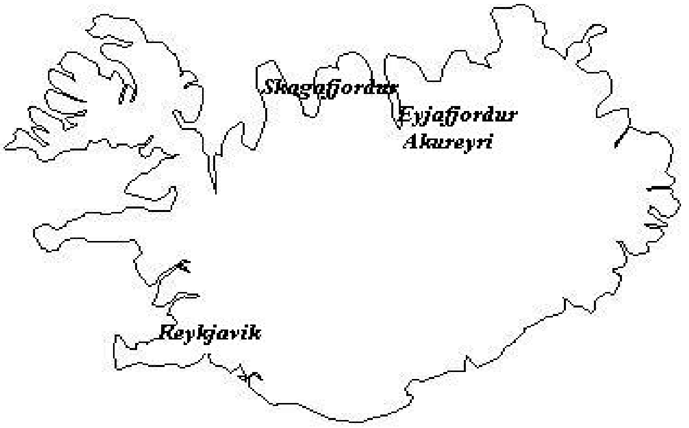
3.2 Iceland

Introduction

When the first settlers arrived from Norway, in Iceland in the 9th century they used turf and stone to construct their farmsteads, this tradition continued well into the 20th century. Turf was used not just for roofing but also to construct walls, with a range of shapes and sizes cut for particular building needs. The sites visited in Iceland were all in the north of the country around Skagfjordur and Eyjafjordur and visits were made to the National Museum and Archive in Reykjavik.

Despite its position on the edge of the Arctic Circle because of the Gulf Stream Iceland has a surprisingly mild climate. In summer the average temperature is just under 11˚c and falls to -2˚c in the winter. The rainfall varies from a skin-soaking 2300mm in the south to only 470mm around Akureyri in the north. It is frequently windy.

Main sites visited in Iceland



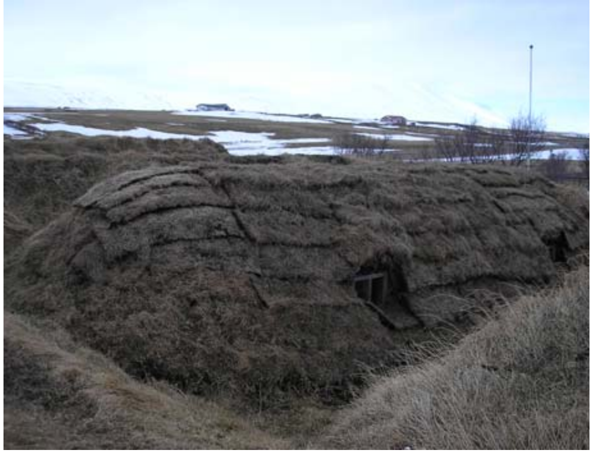
Glaumbær

The farmhouse and vicarage at Glaumbær, Skagafjörður

Glaumbær is a large farm and vicarage in Skagafjörður, the building has developed from a medieval passageway farmhouse and in its latest phase was a complex of rooms all constructed of turf around a timber frame. It was occupied until the mid-20th century and is now run as a museum. Sigridur Sigurdardottir, the director of the museum, explained the different types of repair carried out at the site.

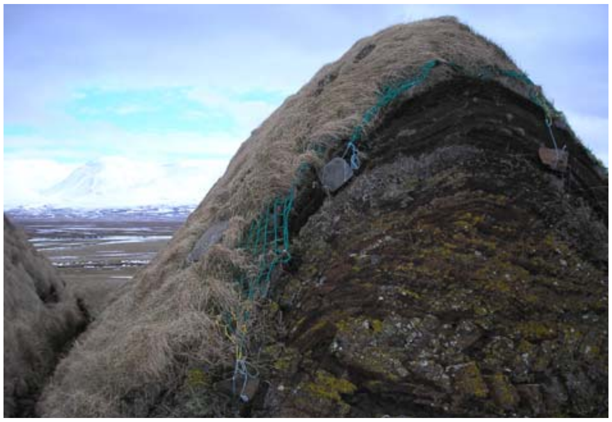
The turf is all cut locally from the wetlands in front of the farm; the best from between the two rivers or alternatively from an old field, not one that has been fertilized in the past 10-20 years. (Unfortunately I couldn't visit the wetlands site because of snow). It was felt that a nutritionally poor site would have stronger root system. They cut from areas where a grass, 'huspuntur' grew, from its description this appears to be *Deschampsia cespitosa.*

The first layer of turf is laid, grass side down, over a waterproof membrane, either birch bark or dried turf, although a rubberized membrane and tarred paper have also been used at this site. A layer of old dung (sheep was proclaimed the best, although in this area horse seemed to be the only alternative) is then laid on top, and then the turfs, grass side up. The turfs are approximately a spade deep and are laid in one of two ways. Either like bricks, with the edges off set, as was seen in the Færoe Islands, or like tiles with larger, square blocks overlapping the row below. These turf tiles are held in place with wooden pegs.



At Glaumbær large square turfs were laid in overlapping tiles

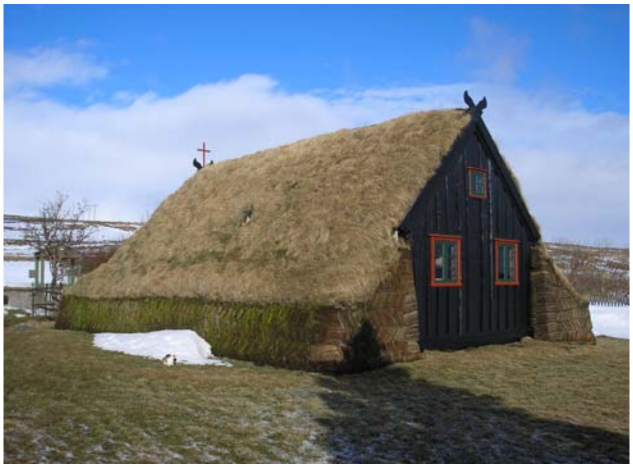
Once in place it was stressed that it was necessary to make sure that the turfs did not move. This was achieved either by using a net laid over the top and weighted with stones, or stones laid directly on top of the turfs. This would be kept in place for 1 to 2 years, until the root system had established. Roofs were repaired every year, focusing on areas where it had started to fail, at Glaumbær this was the south aspect of the roofs, the north tended to survive better and needed less repair. As the summer climate is quite dry at Skagafjörður they do water.



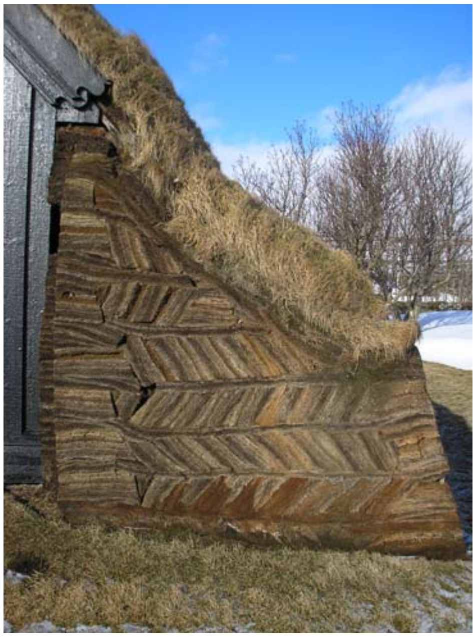
Roofs are held in place with a weighted net

Víðimyri

A church was built at Víðimyri in Skagafjörður in the twelfth century, although the present building dates from 1834. It is a timber frame construction covered in turf. The building was purchased by the National Museum in 1936 and has been in their care since. The roof and walls underwent extensive repair in 1999.



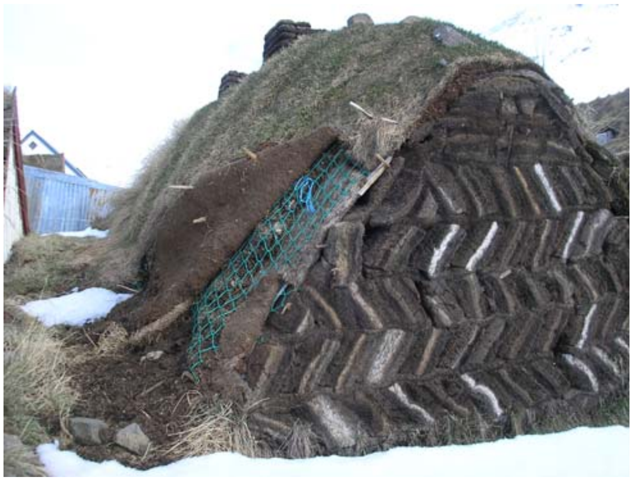
Like most turf buildings in this area the turf for the walls was sourced in the low lying valley bottom and is cut from the wetlands ‘ with the flood’ i.e. in the Spring. These turfs appear to be cut from marshland with anaerobic conditions and are growing in a dense vegetation mat, which makes a perfect block which does not lose its shape when dried out. The turfs chosen for the walls are composed of a blocks – *hnaus*, laid alternately with long sods of turf -*strengur.* The roof turfs appear to have been cut from land at a slightly higher elevation and were composed of the same grass as the surrounding pasture. Unfortunately this grass samples taken from the roof were not dried properly and the grass varieties could not be identified. The roof was a three layer system with the turf first laid grassy side down, then a layer of earth and then a top layer of turf grassy side up. The roof was laid on a timber frame covered with a tarred paper to provide a waterproof membrane. The first summer the roof was watered every day from June – August; the climate in Skagafjörður is quite dry in the summer. They do sometimes cut the grass and fertilise the roof every third year.



Detail of the east gable of Víðimyri church. Note the blocks – hnaus*, laid alternately with long sods of turf* -strengur

Laufás

Laufás is a fine example of a 19th century turf farmhouse located 30km northeast of Akureyri in Eyjafjörður; it is now in the care of the National Museum. Like Glaumbær the building is timber-framed and fronted, with turf forming the insulating walls and roof. Like the other buildings visited, the farmhouse sits on a rise above the flood plain. Again the turf from the walls is cut from the wetlands close to the site and the roof turfs are local outfield. Through the years different repair techniques have been used, however today there is a movement towards using traditional materials wherever possible. This is not only because they are authentic but also because in many cases they work very well. Therefore at Laufás the waterproof layer ranged from traditional turf and tarred paper but also included late 20th century



introductions of corrugated tin and rubberized membrane. These more modern materials were not deemed to be successful. The smooth surface made it difficult for the grass to gain a hold and these roofs needed more frequent repair. A recent storm had caused damage to a recently repaired section of roof, exposing its structure; a base waterproof layer (rubberized membrane), nylon fishing net, a turf layer, a layer of manure, nylon fishing net and then large turf squares held in place with wooden pegs. The net was used here, not to keep the turf in place but to give the roots something to hold onto.

The 'turf tile' method, seen at Glaumbær, was also use at Laufás but in this case the tiles were curved and had been used to repair along a ridge.

Conclusion

In the past the inhabitants of Iceland embraced turf as a readily available and versatile building material with important insulating qualities and used it not only for roofing but also for walls and chimneys. In Iceland there are special tools for cutting the different shapes of turf and names for all the different shaped blocks they produce. However today the use of turf is not so widespread and is largely confined to traditional buildings in the care of the National Museum or other heritage groups. I was informed that there were now only a handful of people who had the knowledge and skills to build and repair a turf house. This situation, of few skilled people and an imminent loss of traditional knowledge, has been recognized and a new course in traditional building techniques was being proposed at the University of Holar in northern Iceland.

Like the Færoe Islands all turf roof appear to have been constructed over a timber frame overlain with a waterproof membrane. Again this was traditionally birch bark or tarred paper and in lower status buildings e.g. a stable was sometimes straw or an additional turf layer. In Iceland the roof was generally a three-layered turf roof; on the inside was turf with the grassy side down, on top of which earth or manure was packed and then a new turf layer placed on top with the grass side up. The actual turfs seemed to be larger and although usually butting against each other were sometimes placed overlapping and pegged, like a slate roof. The roof was kept in place with stones, weighted nets and in some cases was protected from uplift and drying out by the wooden barge board.

There was more evidence for aftercare in Iceland with watering and fertilising taking place. This may be because of the difference in climate, northern Iceland is much drier than the Færoe Islands; the poorer soils, the near Arctic conditions in Iceland mean the soils are poorer in nitrogen and phosphorus, essential for plant growth; or even the difference in architecture which allows easier access to the roof. There was no evidence for grazing or cutting the grass.

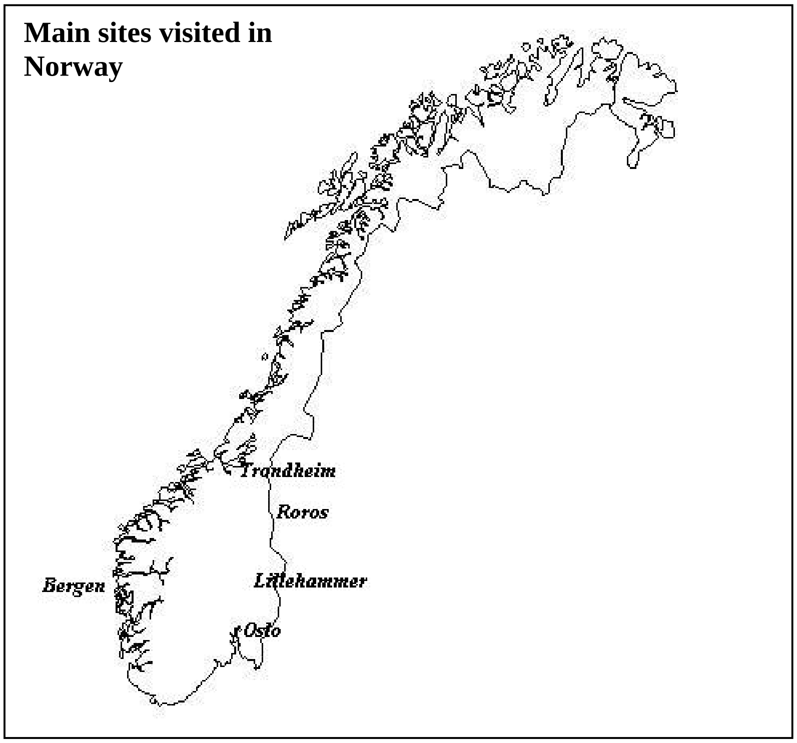
Iceland shares a common Scandinavian (particularly Norwegian) origin with the Færoe Islands and to some degree Western Scotland and the vernacular architecture shares many common themes. However I would suggest that the use of turf on such a wide scale for both roofs and walls is one that was perhaps always more widespread in Iceland than elsewhere and certainly continued much longer; lasting into the latter half of the 20th century. However today nearly all turf buildings are in the care of museums and heritage groups and their repair and maintenance is carried out by a decreasing number of skilled people.

3.3 Norway

Introduction

The use of turf as a roofing material occurs in all areas of Norway and was the most common roofing material in the country from prehistoric times to around 1900. It was settlers from Norway that took their building traditions to the Færoe Islands, Iceland and the west of Scotland in the medieval period.

During this trip I looked at four sites in the southern half of the country. However three of the sites were folk museums and had buildings re-constructed on site from a much wider area.



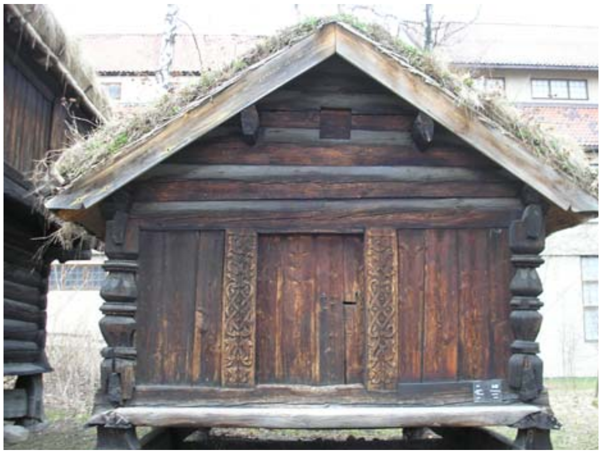
Main sites visited in Norway

Norsk Folkemuseum, Oslo

The Norwegian Folk Museum was established in 1894 in the grounds of the King's summer residence at Bygdøy on the outskirts of Oslo. Today it is home to over 150 buildings reconstructed on site. The buildings represent the vernacular architecture of many regions of Norway, from Trøndelag in the centre to Jæren on the south coast. The only buildings from north of Trøndelag were two Saami seasonal buildings. A great many of these buildings, particularly from rural sites, have turf roofs.

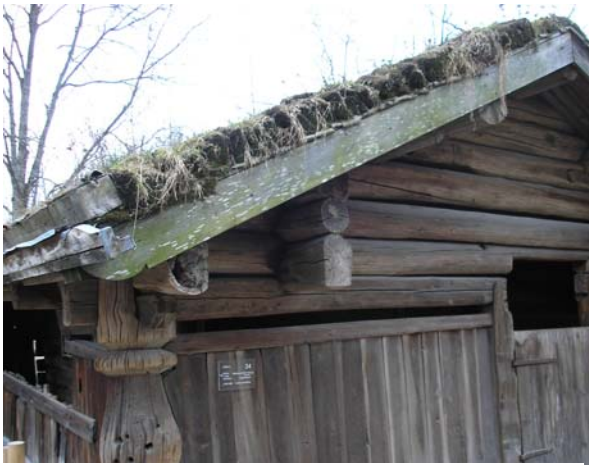
At the Norsk Folkemuseum they now try to repair using traditional materials. However as they are an urban museum they do not have ready access to these and so, for roofing, this means importing birch bark for the base waterproof layer and buying in turf from a local garden centre. The turf is supplied in rolls or in $0.5m^2$; this is for ease of working, any bigger and the turfs would be too heavy to carry and work with. Although initially a typical grass composition for a lawn, within 3-4 years the composition of species have changed as local seed sources take over. The Norsk Folkemuseum lies in a very sheltered and wooded area and there is sometimes a problem with saplings growing on the roofs.

Once a roof is repaired the life expectancy is approximately 25-30 years, this reflects the life of the birch bark layer, plastic and rubberized membranes last longer. The most common method used at the Norsk Folkemuseum was the two-layer system, with the bottom layer with the grass side down and the top with the grass side up. The total depth of the roof was usually around 0.15m, so each turf is approximately 75mm. Sometimes it was necessary to carry out small repairs to the turf, usually along the edge and roof ridge, when this happened they repaired by placing overlapping turf tiles. The edges are protected from the wind either by barge boards or by putting stones or planks along the edge.



A barge board protects the vulnerable turf edge

The 'milk carton' method, noted at Hoyvik in the Færoe Islands, was used to repair the roof of an 18th century *eldhus* or exterior kitchen from Numedal. Numedal is a central valley that extends from the Hardanger plateau. The turfs are the approximate size and shape of a 2 litre milk carton and are laid in a single block depth with the turf facing towards the ridge. When first completed the roof looks like soil with thin green horizontal stripes of grass. This method was explained as just another way of doing things and was not believed to be associated with any particular region or building.



The shapes of the 'milk carton' turfs can be seen along the roof edge

On all buildings at the Norsk Folkemuseum once a roof is completed it is watered and then has very little maintenance. Trees are removed, as the roots would penetrate the birch bark and cause water seepage, and the grass is occasionally scythed, although it was stated that traditionally sheep or lambs would be put up to graze.

Maihaugen Museum, Lillehammer

The Open Air Museum at Maihaugen on the outskirts of Lillehammer opened in 1904 with a small collection of local buildings from the surrounding area; today it has 190 traditional buildings on site from the Gudbrandsdalen, the valley that stretches north and south of Lillehammer. Most of the buildings have turf roofs, although many buildings from the mountain areas have roofs of slate or flat stone slabs.

At Maihaugen they now have a policy to repair using traditional methods and have introduced a scheme amongst local farmers to provide them with birch bark. Wherever possible the grass is cut locally from pasture, preferably from poor quality fields. The turfs are cut to the depth of the roots, maximum c.0.15m. They are laid in the two layer method with the bottom layer with the grass side down and the top with the grass side up. The turf is held in place with barge boards or stones along the edge. Once the roof has been laid it should last around 50 years with little or no maintenance.

Sverresborg Museum, Trondheim

The Open Air Museum at Sverresborg dates back to 1909 and today has more than 60 traditional buildings from the surrounding Trøndelag area. This includes mountains and coast-land and buildings from Saami huts to town houses. Most buildings date from the 18th -19th centuries.

Construction of turf roofs at Sverresborg is usually carried out in early May, just as the grass is growing and before the driest months in this area of late May – June. Local pasture is used with no pre-preparation; some of the turf is sourced from the site which covers 75 acres. The most common method is the two-layer method, with the bottom layer with the grass side down and the top with the grass side up. The turfs are approximately 0.1m deep and cut in long strips, these strips are cut as long as possible, approximately 1m but still small enough to carry and manoeuvre. It was explained that the turfs have to be at least 0.1 – 0.15m deep as any thinner and they would be vulnerable to drying out and blowing away. At Sverresborg the turfs are apparently laid randomly to fit and not in ordered rows. If the joints are not tight they are packed with soil.

Barge boards are very common in the traditional architecture and provide both a stop to prevent the turf from slipping and protection from wind drying out and lifting the turf along the vulnerable edge. It was stated that the pitch of the roof has to be at least 10˚ and not too steep (45˚ maximum) otherwise the soil will fall off. There is no after care or maintenance, except weeding out saplings.

At Sverresborg they have limited access to turf so have on occasion just put up soil onto the roof and seeded it with a propriety seed mix and then fertilized it. This technique was acknowledged as being a modern reaction to a particular problem and was probably not traditional. However the method was successful.

Museum staff also expressed the opinion that traditionally small repairs to roofs would be carried out probably on an annual basis; however because of limited resources this was not the case at the museum.

With a good layer of birch bark and favourable conditions a turf roof should last 100 years.

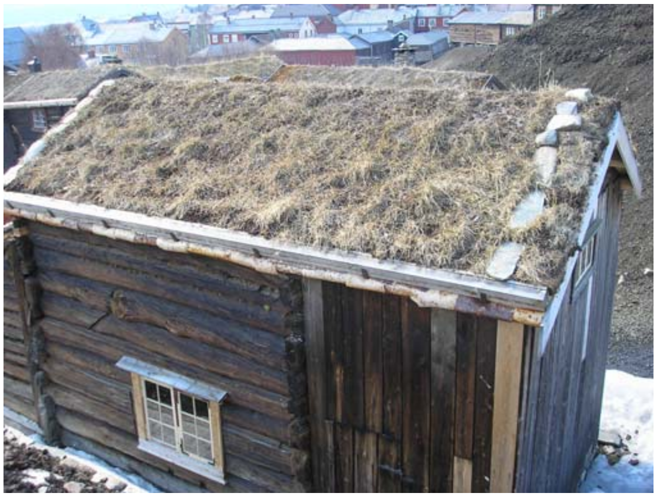
Røros

Røros was an important copper mining town for over 300 years from 1644 until 1977. In 1980 the old town and mine was included on the UNESCO World Heritage Site List. Lying close to the Swedish border and at 600m above sea level the conditions at Røros are inhospitable with short summers and with a record breaking -52˚c winter temperature. Røros was different from the other Norwegian sites visited as it was an industrial town, the buildings were in use, they were in their original position and the climatic conditions were more extreme.

The miners at Røros were also small scale farmers and it is their homes and farm buildings that are turf-roofed. Higher status buildings, the church, manager's and merchant's house all had slate roofs.

The miners houses in *Sleggveien* (Slag Road) are all roofed using the two layer method, with two layers of turf laid on top of a layer of birch bark. The bottom layer is laid with the grass side down and the top with the grass side up. The turf was sourced from the small fields and farms surrounding the town, from pasture land, or poor quality grassland. It was very noticeable that the grass composition at Røros was different from that seen elsewhere with more mosses and lichens evident. Unfortunately it was not possible to take samples from any house in Røros. The turf was kept in place with barge boards and / or stones. Stones can be an issue in this area as frost heave can move them substantially and they can be pushed off the roof.

Today most of the houses in Røros are managed by a local heritage association, either directly or through conservation agreements and there is a movement towards using traditional materials and methods. Today most roofs are repaired using birch bark, in the more recent past various materials were used including asbestos sheeting and corrugated tin. However turf is still placed on top, not only to keep with tradition but also to provide an important insulating layer in this harsh climate.



A miners house in Sleggveien, *stones prevent wind uplift*

Conclusion

Turf roofs are still to be found on many Norwegian buildings, traditional and modern 'rustic'. The method used was nearly always the two-layer; the bottom layer with the grass side down and the top with the grass side up on top of a layer of birch bark. Two other methods were noted – the 'milk carton' that had been observed in the Færoe Islands, and a soil and seed method, although this was purely because of a lack of resources. However all these methods appear to be successful. The importance of keeping the turf in place was again stressed and this was achieved through the 'turf-stopper' board and barge boards as well as stones along the vulnerable edge; timbers and roof tiles were also noted performing this function. Steepness of slope was considered to be a factor - the slope of the roof has to be steep enough so that water can run off but not so steep that the turfs slide off. Roofs were steeper on the west coast, which has higher rainfall then in the inland drier areas. Norway also has a more varied weather pattern than the other areas visited and west coast Scotland, with Røros experiencing much colder winters and drier and hotter summers. However grass is able to grow within these conditions and so can be used as a roofing material, although the composition has a higher percentage of lichens and bryophytes. Aftercare was again minimal or non-existent. Traditionally sheep and goats were occasionally put up to graze, but this was to use an important food source not as a method of maintaining a roof.

The use of turf on roofs in Norway was to act as an insulating layer and weight to keep the waterproof birch bark in place.

4.0 Conclusion

This trip was to look at methods of construction and repair of turf roofs and the factors that contributed to success or failure. The areas visited were chosen because of their climatic, vegetative and cultural similarities to the west coast of Scotland. Factors which were considered included;– use of the building, size and area of roof, aspect, steepness of slope, type of turf used, size and shape of turf, time of year of repair / construction, varieties of grass as well as after care; watering, fertilizing , grazing or mowing. Life expectancy and frequency of repair were also considered.

All the turf roofs in the areas studied were different to those on St Kilda, in that they were all constructed on a timber roof and the function of the turf was to hold the waterproof layer in place and to provide insulation. Traditionally in all the areas studied this waterproof layer was birch bark, imported from Scandinavia, or tarred paper. In many places this had been replaced by commercial modern materials, such as a dimpled plastic sheet or a rubberized material. On St Kilda the turf roofs are all above a stone construction and are formed of soil and turf only.

Factors which had no or minimal affect on success or failure included the size and area of the roof: roofs from the very small – dog kennels and sheds to large churches were all turfed. Steepness of slope had a minimal affect, flat and shallow pitched roofs were all noted with successful turf roofs; 45˚+ roof pitches were also noted although any steeper and it becomes trickier to construct as there is the problem of the turfs slipping off. Shallow roofs may occasionally become waterlogged but as long as the structure is designed to take the additional weight then this is not a real problem.
Aspect of the slope has some affect on the success; the south aspect is more exposed to solar radiation and so has a tendency to dry out more. This causes shrinkage and can then make the turf more vulnerable to wind. Problems tend to appear first on the south aspect and this aspect tends to be repaired more frequently. However these are relatively minor issues which can all be solved.

The turf itself was important, roofs are quite harsh areas for grass to grow; they have thin nutrient poor soils and are often exposed to wind and solar radiation, creating strong drying conditions in the summer. Nearly all sites chose turf from nutrient poor soils, only one, the Norsk Folkemuseum, used higher quality turf bought in from a garden centre. However the site of the Norsk Folkemuseum is very sheltered and the grass composition soon changed to reflect the local grass species. In both the Færoe Islands and Iceland it was stated that the grass should come from the outfield land or an old field- one that had not been in use for several years. This is borne out by the grass composition which is typical of unimproved upland habitats. The use of turf from this type of land means that not only is good quality grass available for the grazing animals but also the grass chosen is better suited to surviving on a roof which may not be fertilised, either artificially or through natural grazing.

The size and shape of turf was also a factor. Turfs are vulnerable to drying out and the more edges exposed, the larger surface area is exposed to drying out. Therefore larger turfs are preferable to minimize the number of edges. However the balance has to be struck between size and weight – large turfs are heavy and difficult to move. The depth of the each turf layer was usually 65-90mm, which was the depth of the root system. In all areas the turfs were laid very tightly together or overlapping, any cracks made the roof more vulnerable to drying out.

Aftercare, particularly watering or fertilizing, was not routinely carried out after the first few days. Minor repairs were carried out as needed. Grazing was noted at a number of sites and was not considered an issue affecting success or failure. A grass roof is in effect a small field and was an important grazing resource. However it was noted that a damaged roof or one needing repair could be exacerbated by livestock poaching the ground and increasing erosion.

The two most important factors that seem to influence success or failure were time of year of repair and ensuring the new turf could knit together. In all areas the majority of repairs were carried out in the early spring, just as the grass is beginning to grow. One major repair was carried out at Glaumbær in the late summer of 2005, these turfs had not yet knitted together and all the time were vulnerable to movement. The success of this repair would only be judged after the spring once the grass had started to grow. The issue of ensuring turfs could not move, either through slippage or wind, was stressed a number of times and a variety of methods were used. Most traditional buildings in this area had a barge board and ‘turf stopper’ board protecting the edges of the turf and providing a firm base from which to build. Turfs were placed tight up against each other and often cut to provide an overlapping joint. Turfs were firmed into place either by thumping or walking on them and then sometimes a weighted net or stones laid on top, timber pegs or logs were also used.

Although in all three areas the building traditions were different to St Kilda, particularly that all the turf roofs visited were constructed on a pitched timber roof which is quite dissimilar from building on a flat stone roof as occurs on St Kilda, the factors influencing success remain the same. To give a turf roof the best chance of success it should be constructed in the spring and be protected from movement and drying out. Fertilising is not necessary and may have an adverse affect by encouraging growth to the leaves rather than the root mass.

5.0 Recommendations for St Kilda

- Turf repairs should ideally be carried out in early spring as the grass begins to grow, e.g. mid to late April
- The turfs should be protected from movement – the soil core should be damp but not wet to avoid shrinkage
- The roof should be held in place e.g. by a net or stones
- The edge is vulnerable – make sure it is protected or secure e.g. stones
- Don’t panic – both in the Færoe Islands and Norway comments were made that the grass composition changed in the first few years. The first year often had weeds etc until drought tolerant species established - give it time.

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